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Research Update Meeting 2005 - Harvest Flooding Affects Seasonal Pattern of Carbohydrate Accumulation in Cranberry Uprights

Justine Vanden Heuvel
UMass Cranberry Station, jev32@cornell.edu

Harvest Flooding Affects Seasonal Pattern of Carbohydrate Accumulation in Cranberry Uprights

Michelle R. Botelho and
Justine Vanden Heuvel

Cranberry Experiment Station

Introduction

– Potential Stress Indicators –

- Cranberries under constant carbohydrate (CHO) stress
  - Low fruit set
    [Roper and Vorsa, 1997]
  - Biennial bearing
    [Roper et al., 1993]
  - CHO varies throughout fruit development
    [Birrenkott et al., 1991]
  - Flooding?

Introduction
– Negative Impact of Flooding –

- Lack of oxygen causes injury [Bergman, 1946]
- Floodwater factors:
  - Flood duration
  - Possible high temperature
  - Dissolved oxygen deficiency
  - Poor water clarity

Introduction
– Greenhouse Experiment –

- Flooding simulation with Stevens uprights
- 2 treatments – control vs. oxygenated
- 2 pots removed every 3 days for 3 weeks

Greenhouse Experiment

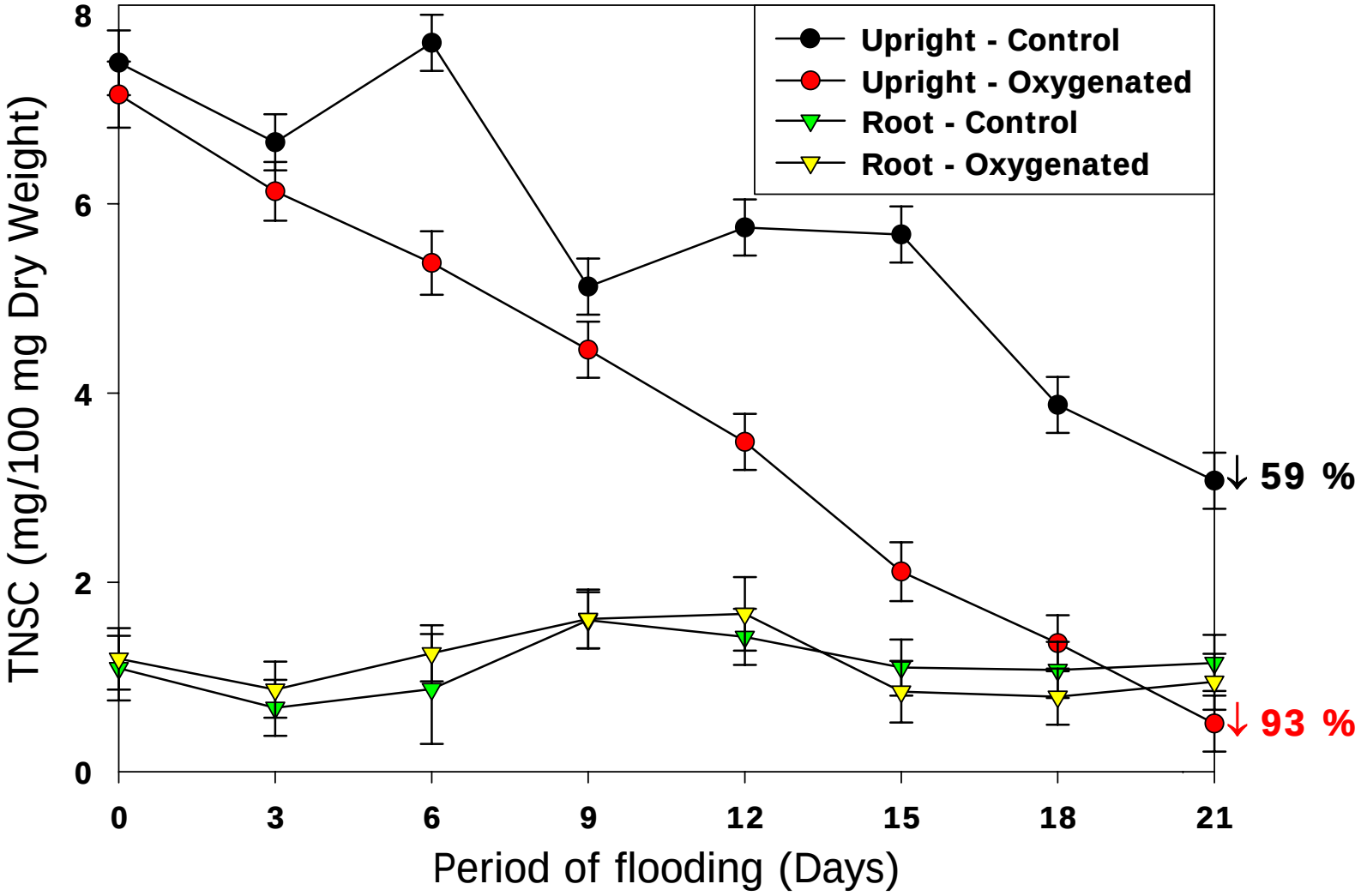

Figure 1: Total nonstructural carbohydrate (TNSC) concentration of 'Stevens' cranberry uprights and roots during a simulated 3-week late water flood. SE is represented by vertical bars.

Greenhouse Experiment

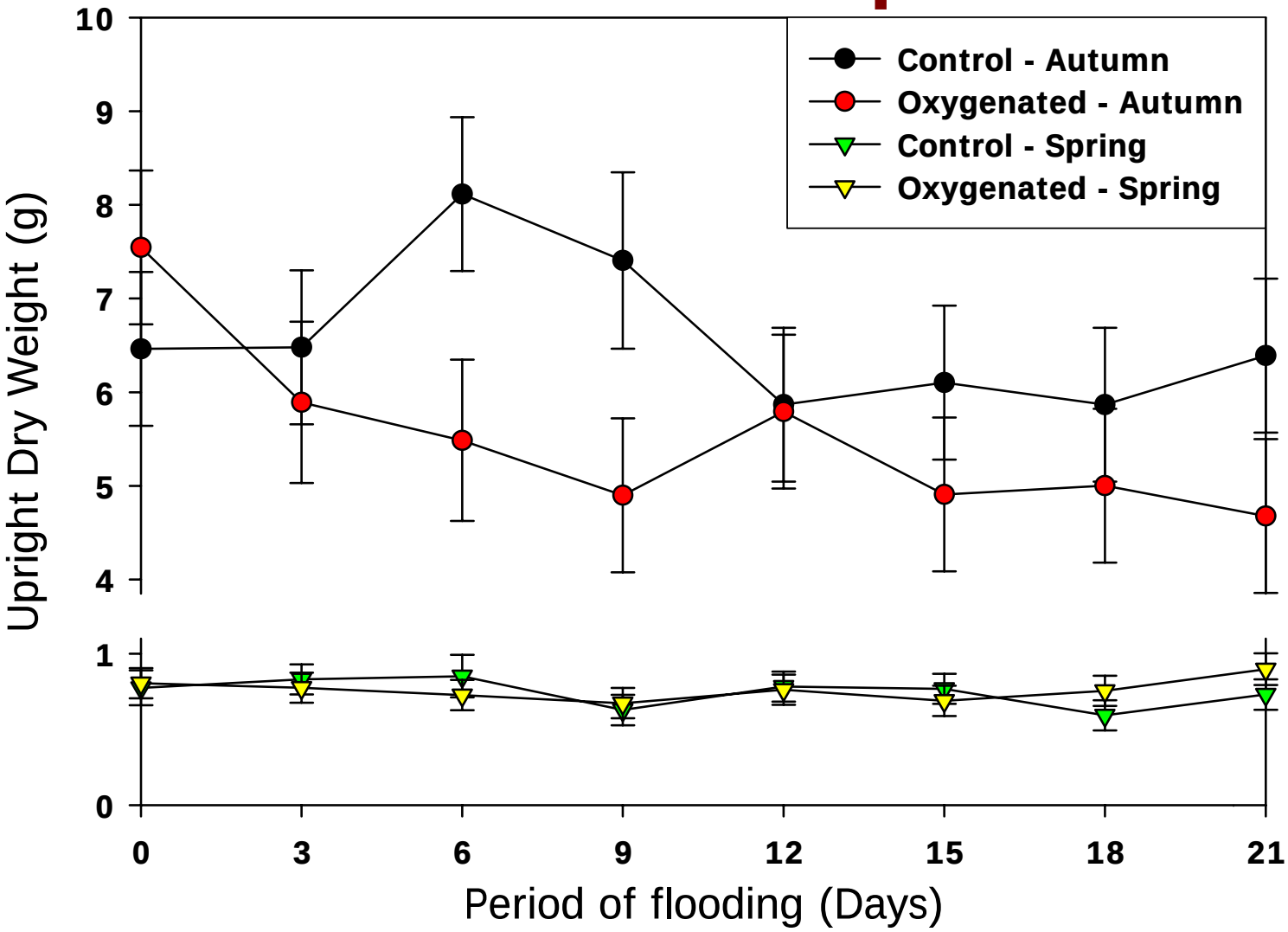

Figure 2: Changes in cranberry upright dry weight after subjection to a simulated late water flood. SE is represented by vertical bars.

Greenhouse Experiment

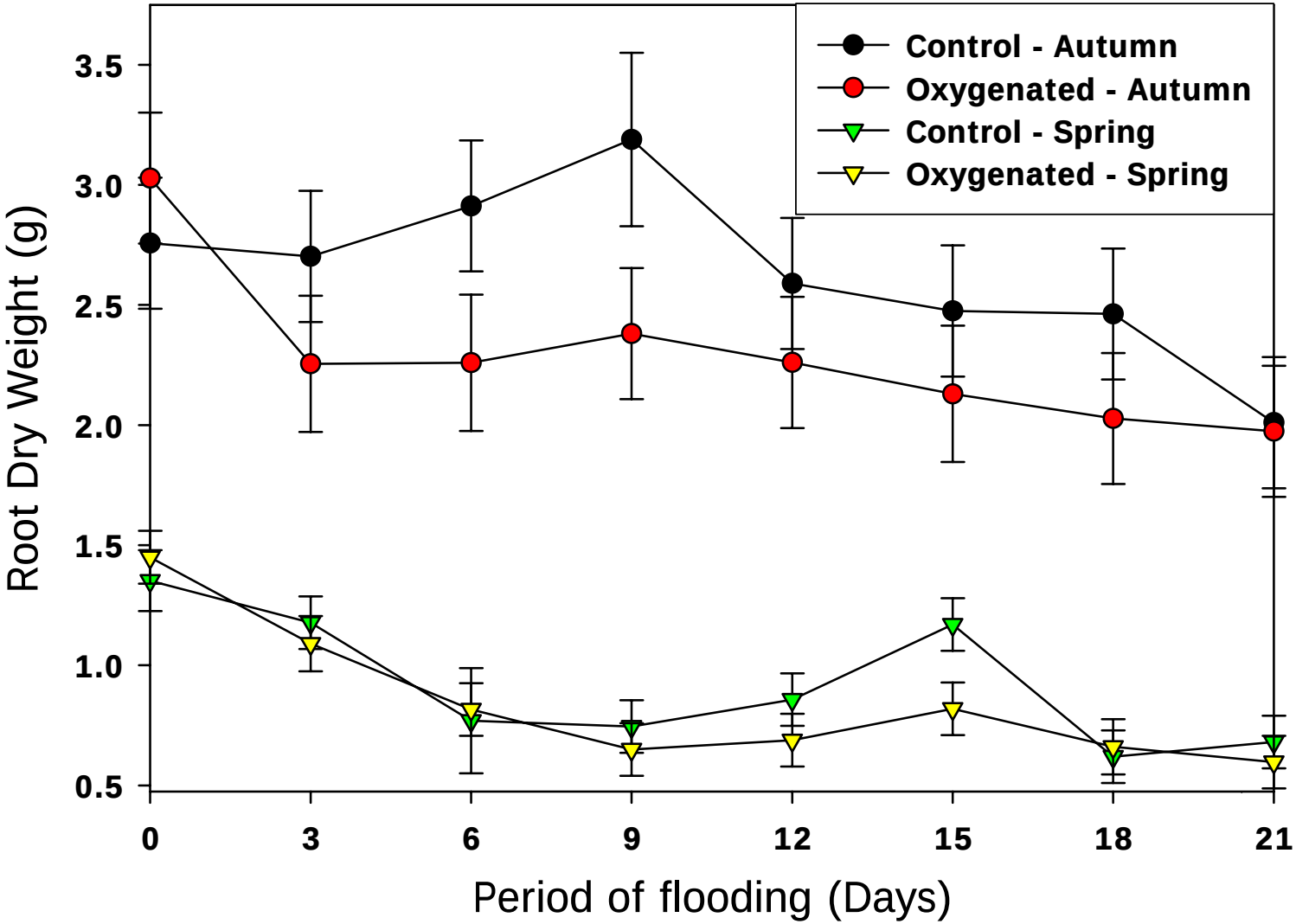

Figure 3: Changes in cranberry root dry weight after subjection to a simulated late water flood. SE is represented by vertical bars.

Greenhouse Experiment

- Contrary to current recommendations, high dissolved oxygen levels in floodwater may have a detrimental effect during a late-water flood

Objective

- Determine the relationship between flooding and seasonal carbohydrate levels in cranberry uprights and roots for EB and Stevens

Methods and Materials

- 2 cultivars
  - Early Black
  - Stevens
- 2 field locations
  - Makepeace Site
  - State Bog (UMass Cranberry Station)

Methods and Materials

- Sample collection
  - Uprights and roots
  - Collected on monthly basis
  - Collected surrounding flooding events
    - Prior to flood application
    - Immediately following flood removal

Methods and Materials

- Flood parameters measured:
  - Flood duration
  - Floodwater depth
  - Water temperature
  - Air temperature
  - Dissolved oxygen
  - Light penetration

Methods and Materials

- Measurement of carbohydrate concentration
  - Starch
  - Sucrose
  - Glucose
  - Fructose

Results

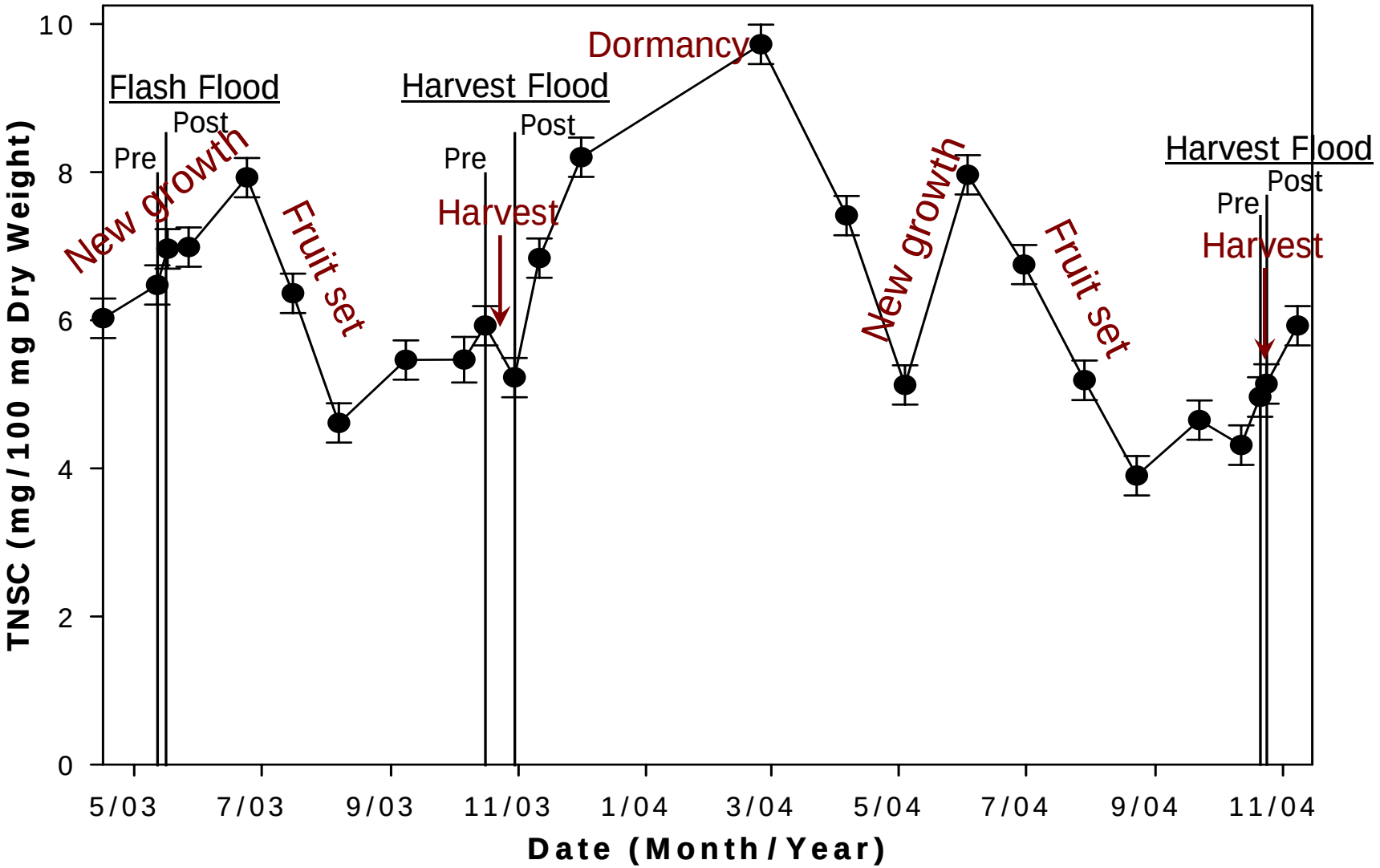

Figure 4: Seasonal changes in 'Early Black' cranberry upright carbohydrate concentrations at a Makepeace Bog. SE is represented by vertical bars.

Results

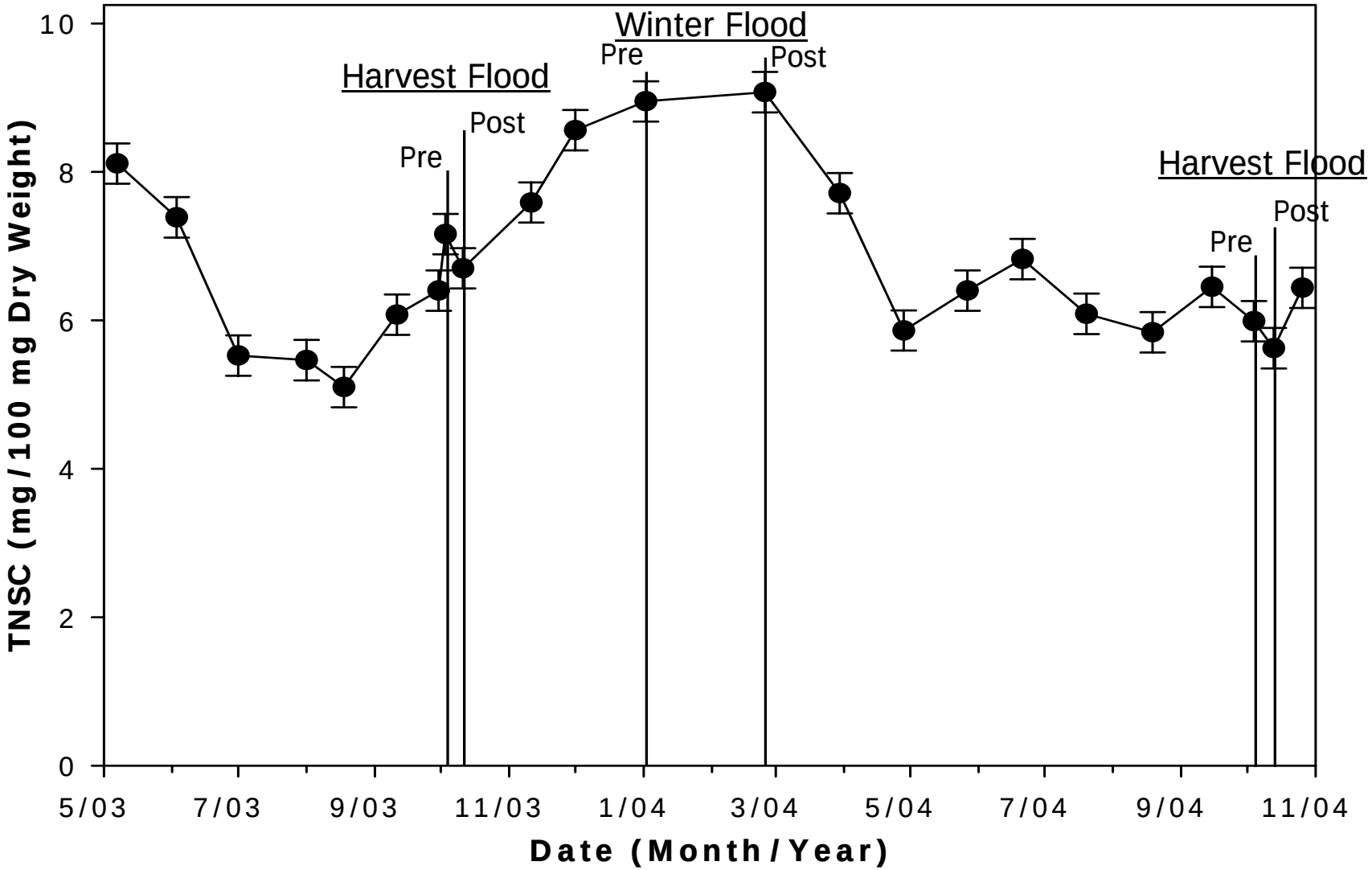

Figure 5: Seasonal changes in 'Stevens' cranberry upright carbohydrate concentrations at State Bog. SE is represented by vertical bars.

Results

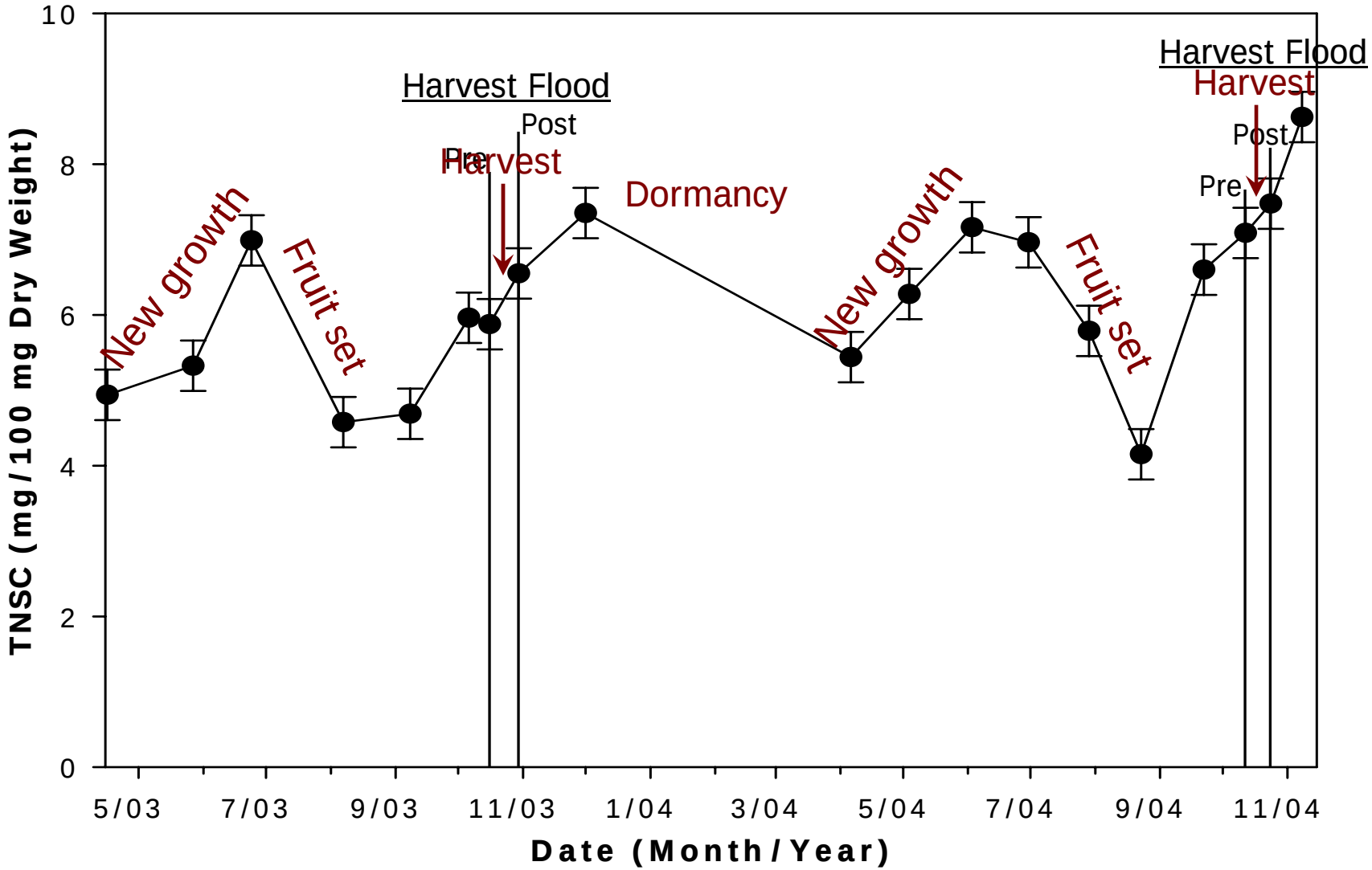

Figure 6: Seasonal changes in 'Early Black' cranberry root carbohydrate concentrations at a Makepeace Bog. SE is represented by vertical bars.

Discussion

- Carbohydrate fluctuations occur throughout the growing season [Hagidimitriou and Roper, 1994]
- Effect of flooding varies by season
  - Winter flood: little effect
  - Flash (Late spring) flood: little effect
  - Harvest flood: larger effect, varied by location and duration

Conclusion

- Opportunity for further CHO accumulation is lost due to harvest flooding
- The possibility exists for a direct negative relationship between flooding and yield

Future Research

- Further investigations into flood parameter interactions
  - Flood depth and duration
  - Dissolved oxygen
  - Water temperature
  - Light penetration
  - Time of flood application

Questions ?

UMass Cranberry Station – October 2004